PUBLIC DOMAIN PACKET RADIO NETWORKS

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Abstract

Communications has always cost money. Data communications, in particular, has until recently been a fairly expensive form of communications, involving expensive terminal equipment and modems. This paper reports on the recent growth of computer networks which are free, having no access charges and no per packet charges. The capital equipment costs to access the network are modest. The networks span long distances, connecting northern and southern California in the West, and Boston to Miami in the East.

1.0 Introduction

The personal computer revolution and the subsequent need for low cost software spawned an underground industry that is huge in scope and employs thousands of people. This industry collects, catalogs and distributes thousands of software packages each year, and it is all done on a volunteer basis. Public Domain Software, as this industry is called, thrives in the U.S. and exists because there are software authors who can write decent programs that fill needs not addressed by commercial packages, and these authors are willing to share their work with others. A distribution mechanism exists in the form of a collection of several hundred telephone-accessible bulletin board systems which users call to retrieve messages and the latest versions of favorite programs. The operators of the bulletin board systems provide computer equipment, disks and modems at no charge, and some of the more sophisticated systems would rival small commercial time-sharing operations.

The popularity of personal computers and the new requirement that they be able to communicate with each other to share public domain software and other messages has led a number of people to be concerned with the problem of improving personal communications, specifically personal data communications. Accessing public bulletin board systems over phone connections can cost a lot of money, especially where toll calls are involved. A very low cost transmission medium is required, one which is not under the control of commercial interests. A medium that satisfies this requirement is a radio frequency (rf) channel which has been allocated for public use, and of the several which are currently available under existing regulations, this paper will consider recent developments which utilize channels assigned to the Amateur Radio Service. In particular, this paper will report on metropolitan and regional area packet radio networks which have emerged within the last one to two years.

2.0 History

The history of packet radio developments in the amateur service has been recently reviewed by Karn, Price and Diersing [1]. In summary, several different groups have designed very low cost packet assemblers/disassemblers (PAD) with on-board voice frequency modems for use with standard voice frequency radios. The protocol in use is a slight variant of the X.25 LAPB specification, with carrier-sense-multiple-access sharing of the radio channel. Transmission is generally at 1200 bps, with some experimentation in progress at 9600 bps. The PAD or terminal-node-controller (TNC) as it is sometimes called, can interface to a large number of different personal computers or ASCII terminals over an asynchronous connection, and the interface to any number of different radios is usually done via the microphone and speaker jacks. The cost of a complete packet radio station can be under $500, with $200 for the TNC and $200 to $300 for the radio.

In the last year the growth of the number of stations equipped for packet radio operations has been phenomenal, and it is now estimated that the population of TNCs manufactured in this country is approaching 10,000, with about half of that number purchased in the last six to nine months. Club meetings and seminars discussing this new technology are heavily attended, and interest is very high from users who wish to implement diverse applications such as emergency nets,

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weather reporting nets, electronic mail, and on-the-air bulletin board systems.

The development of this low-cost but highly reliable form of communications has not been overlooked by interests in the commercial/industrial/government sector. The packet radio equipment developed for the amateur service can be used anywhere there is a need for a reliable data communications path where a radio frequency is available. In rugged terrain where phone connections are few or non-existant, a radio connection is often easily established and can be used for data communications. Mountain-top repeaters can increase the range and number of connections available.

3.Ø The Era of Metropolitan Nets

For several years, while the concepts and technology of low-cost packet radio networking were being developed, the activity tended to cluster around large metropolitan areas. Cities such as San Francisco, Washington, and Los Angeles in the U.S. and Montreal, Ottawa and Vancouver in Canada were the sites of packet radio activity. Twenty to forty stations would share a channel, but the overall loading was fairly light because only a few stations would ever be on simultaneously. The inability to communicate with neighboring metropolitan centers kept the traffic volumes low, and users would generally get on once or twice a week to check their mailbox for new messages. Nevertheless, the number of users kept growing, and the size of the metro-nets kept increasing while new equipment, software and protocols were being tested.

4.Ø The Growth of Regional Nets

Starting about one to one and one-half years ago packet radio repeaters were installed which formed the links between the major metropolitan centers. The New York to Washington path was one of the first completed, followed shortly by Boston to New York and San Francisco to Los Angeles. Today, paths exist from Oregon through California to Arizona, with spurs going to Nevada, and from Boston to Miami. Other links connect Chicago and St. Louis, the major cities in Iowa, and parts of Texas. These regional links have provided the critical mass to fuel the growth of packet radio networking, as each new connection brings together a more diverse collection of users and applications. Network usage has grown to such an extent in the Northeast corridor that some channels are considered saturated, and groups are actively exploring ways to relieve the congestion.

Dr. Tom Clark, an operator of one of the most popular packet bulletin-board systems in the greater Washington D.C. area recently put out a message commenting on the November 1985 activity on his system:

"There were 163 different users this month (a new record) and the system was busy some 32% of the available time. Another record was that a total of 1124 messages "flowed" thru the system, an average rate of 1.7 messages per hour. Since the BBS went on in Sept. 1984 we have now handled over 10,ØØØ messages. I have noticed that late in the month we were seeing 1-3 new users each and every day. Several indicators show that activity is doubling every 4-7 months. These include the number of users, the number of messages handled, and even hassle factors!"

5.Ø Nationwide Nets

Although no East-West links exist today, the author predicts that by 199Ø there will be a terrestrial transcontinental path available. Work on end-to-end routing and transport protocols is being done by several groups, and by the end of 1986 some form of large-scale networking protocol should be generally available.

6.Ø Applications

Three primary uses account for much of the current activity on these networks:

Bulletin Board Systems
Electronic Mail Forwarding
Person-to-person Communications

The Bulletin Boards Systems can be used to exchange messages, to post notices of meetings or other activities, to make inquiries and to allow people to comment on the general state of the world. There exists a mechanism to forward messages left on one bulletin board to another through an intermediate series of other systems. The mail is transferred hop-by-hop, with each message system handing its traffic to its nearest neighbor. The BBSs also can be used as repositories of files, where users can find new programs, updates to the control software, technical articles and documents, and the like. If not connected to a BBS, a person can make direct contact with any other user on the network, either directly or through an interconnected set of repeaters.

Packet radio nets have already been used for emergency and disaster communications, for weather nets and hurricane watching, for public events administration, and for the transmission of non-text information such as high resolution color pictures.

7.0 How Public is Public Domain?

Currently the operator of a packet radio station in the Amateur Service is required to hold a valid license from the Federal Communications Commission. This obviously restricts the growth of this form of communications to those that are willing to put in the time to study for a license, and it restricts the nature of the communications, as no commercial or day-to-day business messages are permitted on the amateur frequencies. It seems likely, though, that as the technology matures and the equipment becomes widely available at low cost, that the general public will be interested in having some frequencies assigned for personal packet communications.

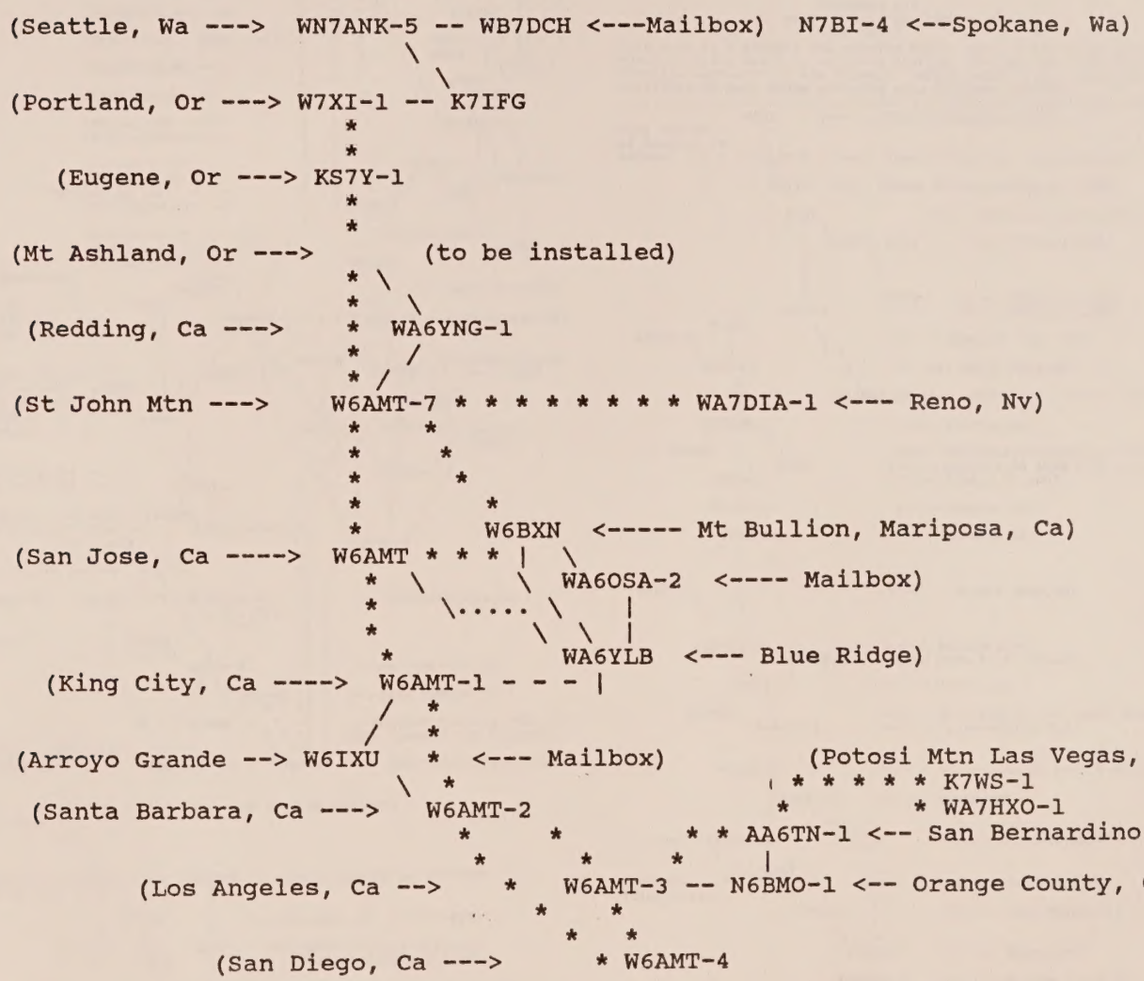
8.0 Survey of Current Networks

The remainder of this article pictorially illustrates the extent of some of the networks in place today. The maps are already out-of-date, as new equipment is coming on-line on a daily basis. Nevertheless, the reader can obtain a mid-1985 picture of the state of public domain packet radio nets.

References

[1] Philip R. Karn, Harold E. Price, and Robert J. Diersing, "Packet Radio in the Amateur Service," IEEE Journal on Selected Areas in Communications, Vol. SAC-3 No. 3, May 1985.

WESTNET MAP
145.01 MHz



Updates and revisions are welcome.
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Revised: November 18, 1985
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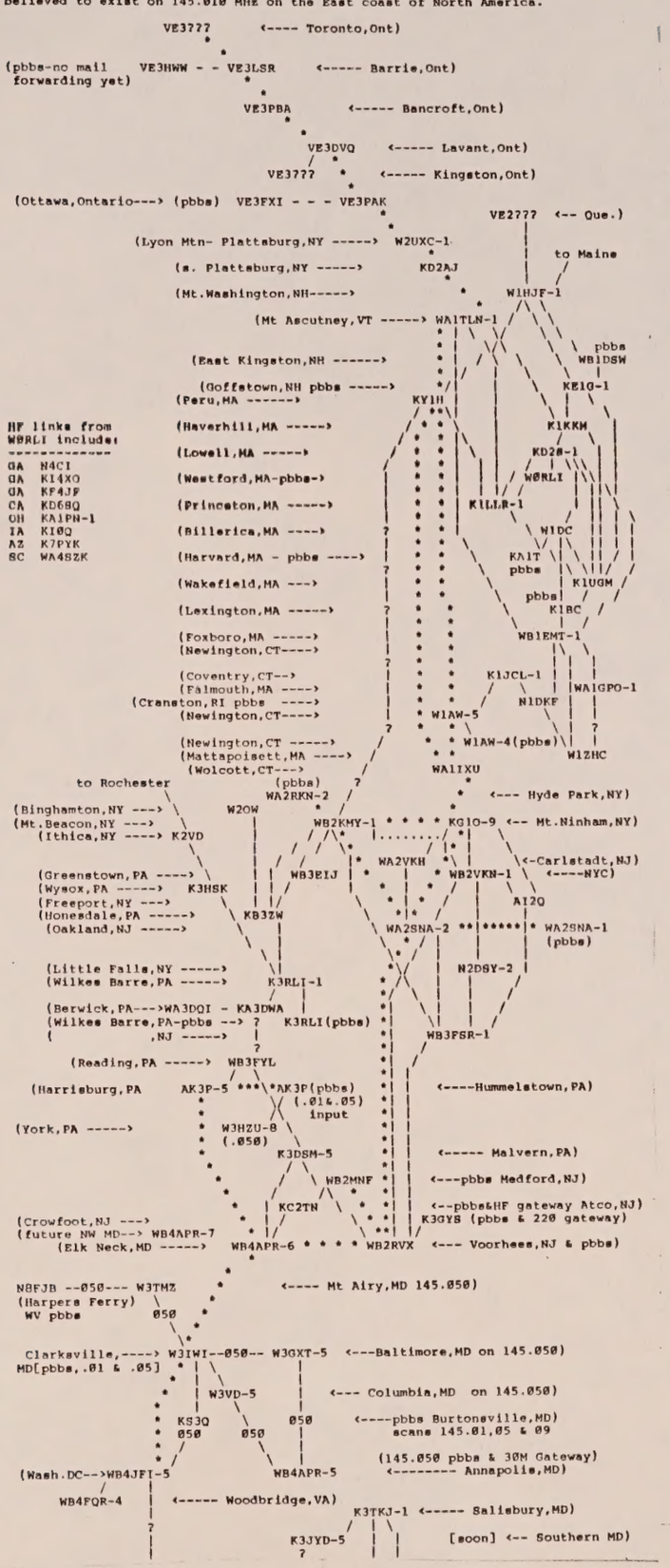
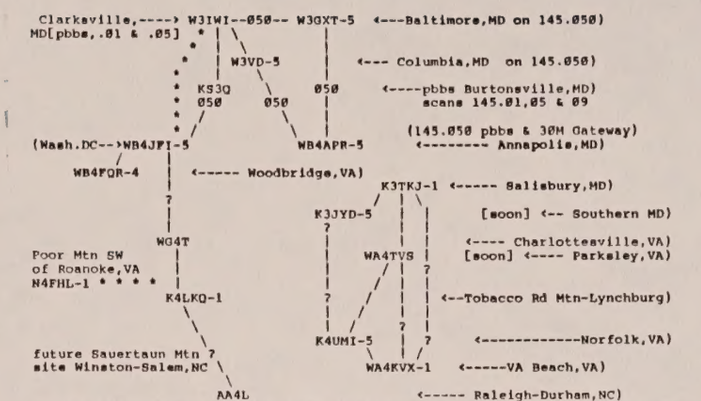
EAST-MAP.015
July 30, 1985
by K1HTV

The following is a graphic representation of Packet Radio links which are believed to exist on 145.010 MHz on the East coast of North America.



Clarksville,----> W3IWI--050-- W3GXT-5 <---Baltimore,MD on 145.050)
MD[pbbs,.01 & .05]
W3VD-5
<--- Columbia,MD on 145.050)
KS3Q
050
050
<----pbbs Burtonsville,MD)
scans 145.01,05 & 09
(145.050 pbbs & 30M Gateway)
(Wash.DC-->WB4JFI-5
WB4APR-5
<-------- Annapolis,MD)
WB4FQR-4
<----- Woodbridge,VA)
K3TKJ-1 <----- Salisbury,MD)
K3JYD-5
[soon] <-- Southern MD)



A graphic map of Packet Radio links south from Virginia south to Florida can be found under the file name of SOUTHMAP.### , available on many of the same PBBSs carrying this EAST-MAP.### file.

Please send any corrections or additions to the above linking map to me, K1HTV @ W3IWI via one of the EASTNET Packet Radio Bulletin Board systems, the U.S. mail, or give me a phone call. Thanks.

73,

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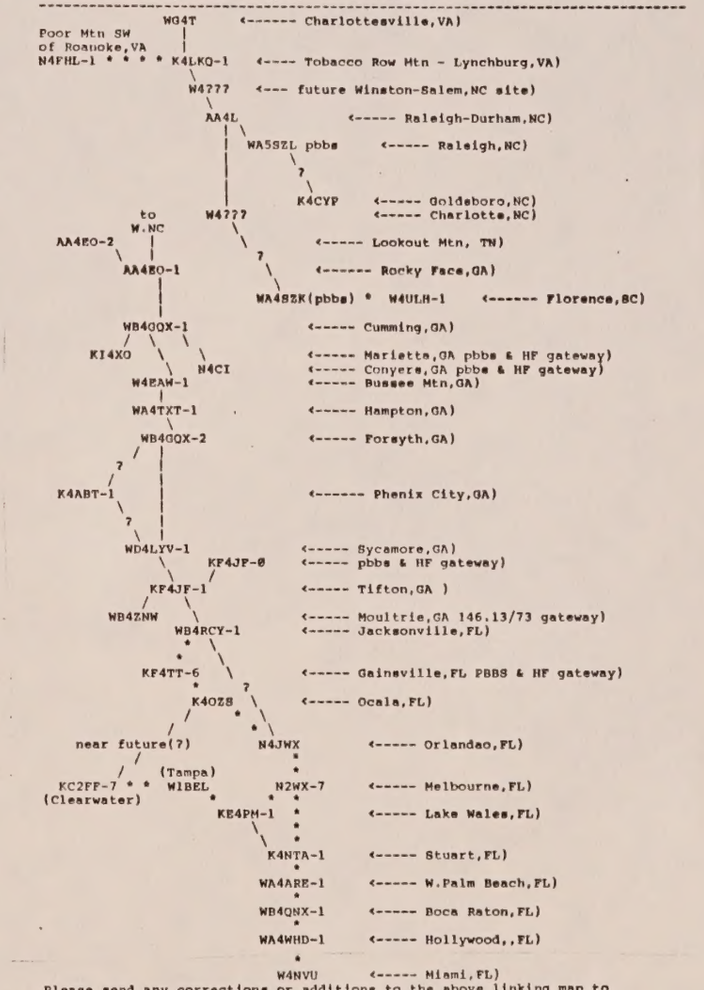
12509 Ransom Drive
Glenn Dale, MD 20769
phone (301)464-2133 (5:00-10:00 PM)

SOUTHMAP.015
Revised July 30, 1985
by K1HTV

This file is a graphic map showing Packet Radio links covering the area from North Carolina south to southern Florida. You can see links the from North Carolina northward to the Canadian border under a file named EAST-MAP.### , available on many PBBSs carrying this SOUTHMAP.### file.



Please send any corrections or additions to the above linking map to K1HTV @ W3IWI via one of the Packet Radio Bulletin Board systems, the U.S. mail, or a phone call. Thanks.